Question 1

Raw coffee beans have a moisture content of 60% on a mass basis. By roasting the beans the moisture content is reduced to 20%. If a coffee bean company is producing 1.5×10^5 kg/day of roasted beans, what is the rate of water being removed during the roasting process?

$(1.5 \times 10^5 \text{ kg})(0.60) = 9.0 \times 10^4 \text{ kg}$ of water originally in the bean. ($\frac{1}{2}$)

$(1.5 \times 10^5 \text{ kg})(0.20) = 3.0 \times 10^4 \text{ kg}$ of what remain after roasting ✓ (2)

MASS OF BEAN ONLY IS CONSTANT

$9.0 \times 10^4 \text{ kg}$

$- 3.0 \times 10^4 \text{ kg}$

$6.0 \times 10^4 \text{ kg/day}$ of

METHOD OK (1)

($\frac{1}{2}$)

6.0×10^4 kg of water is being roasted away in one day. ✓

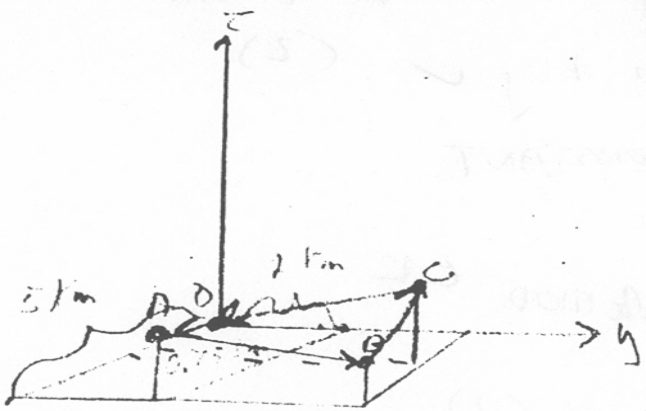
SIG FIG

Question 2

A helicopter flies to the following destinations, in order, and then returns to the starting point. Although it flies to each destination in a straight line, the coordinates of the destinations, with respect to the starting point, are given as follows:

	East	North	Elevation
A	5km	2km	0.75km
B	5km	4km	0.25km
C	2.5km	4km	0.75km

a) What is the total distance that the helicopter travels?
b) What is the unit vector of the direction of the last leg of the trip?



$HA = \sqrt{5km^2 + 2km^2 + 0.75km^2}$

$HA =$

distance to point A = 5.49 km

$AB = \sqrt{(5-5)km^2 + (4-2)km^2 + (0.25-0.75)km^2}$

b) $\hat{u} = \frac{(-2.5km\hat{i} - 4km\hat{j} - 0.75km\hat{k})}{11.75km}$ distance AB = 2.45 km ?

$= -0.21\hat{i} - 0.34\hat{j} - 0.06\hat{k}$

distance BC = $\sqrt{(2.5-5)km^2 + (4-4)km^2 + (0.25-0.75)km^2}$

2.55 km

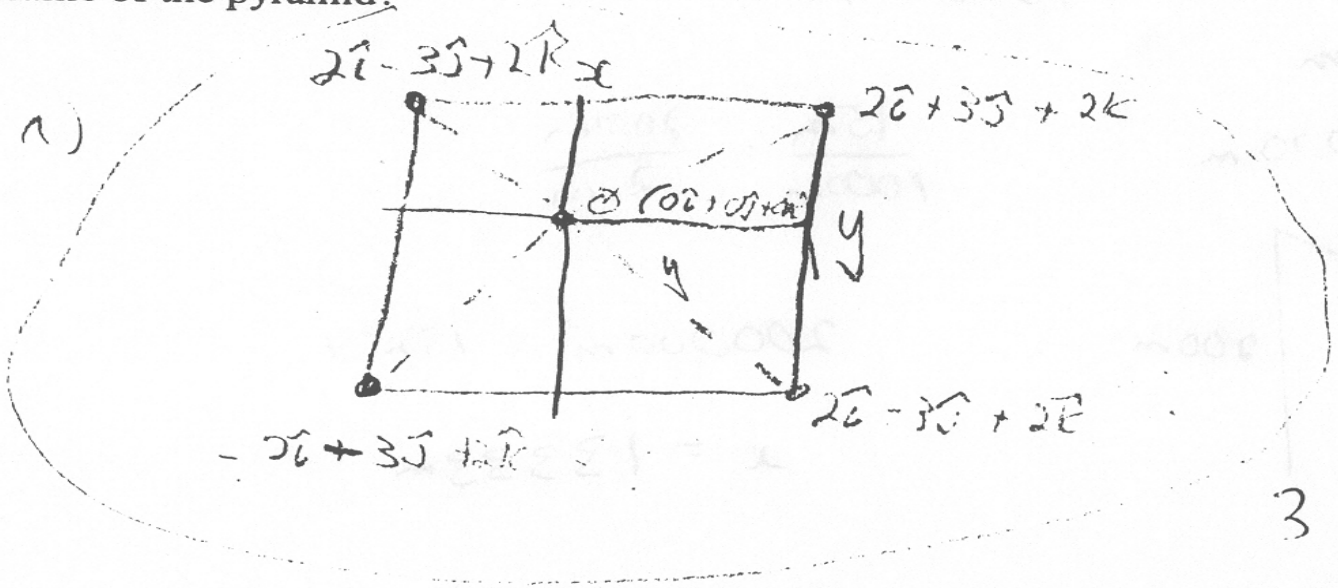
$|\vec{BC}| = \sqrt{(-2.5km)^2 + (4km)^2 + (0.5km)^2}$

3

Question 3

An inverted pyramid, with a square base parallel to the X-Y plane has its apex at the origin of a cartesian coordinate system. The position vector of one of the corners of the base is 2i + 3j + 2k m.

a) Sketch the top view of the pyramid
b) What is the height of the pyramid?
c) What is the area of the base?
d) What is the volume of the pyramid?



a)

3

I am assuming the base is a square

b) 2m ✓2

c) $A = BH$

$= 6(4)$

$= 24\,m^2$ ✗

Question 4

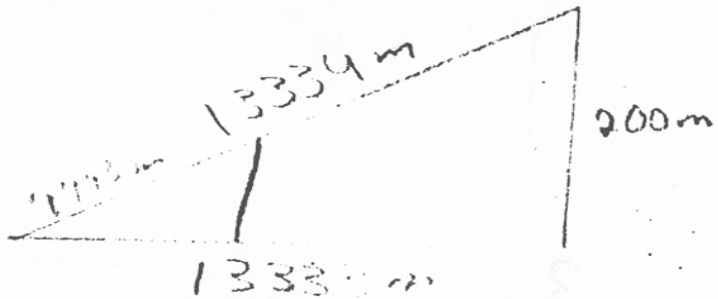
A cyclist is biking along a straight road up a hill with a constant slope (15m rise / km horizontal run). The hill has a height of 200m. At the bottom of the hill, the cyclist was using a high gear. A third of the distance up the hill, the cyclist tires and shifts to a lower gear, dropping his speed by 1.5 m/s. If it takes the cyclist a total of 30 minutes to cycle up the hill, what is his speed on the lower portion of the hill? Assume that the cyclist's speed is constant on the lower part of the hill and on the higher part of the hill.

1000 m / 1 km

$m = \frac{15m}{1km}$

$m = 15m / 1000m$

$\frac{15m}{1000m} = \frac{200m}{2}$



$200000m^2 = 15m^2$

$x = 13333m$

$a^2 + b^2 = c^2$

$\sqrt{200m^2 + 13333m^2} = c = 13341m$

$13334m - 4445m$

$l_2 = 8889m$